2.0.2 DATA ACQUISITION

ARB's data acquisition is composed of both electronic data acquisition systems (data loggers) and strip chart recorders (strip charts). Both data loggers and strip charts are operated at all ARB ambient air monitoring stations for either primary data acquisition (data loggers) or for backup and troubleshooting (strip charts).

2.0.2.1 GENERAL DESCRIPTION

The task of data acquisition involves: retrieving ambient air quality data from the strip chart, data logger or microprocessor-based data acquisition system; transmitting the data from the field stations; and reviewing and editing the data.

2.0.2.2 RESPONSIBILITY

The station operator has the primary responsibility for distinguishing valid measurements from indications caused by malfunctioning instruments or source interference (e.g., roofing, gasoline vapors, or structure fires). The section lead technician and the section specialist or engineer are responsible for reviewing the work done by the field technicians as the second level review in the data validation chain.

2.0.2.3 GENERAL HINTS ON DATA REVIEW

Data review will be greatly enhanced if the station operator is conscious of several aids. These are listed below:

1. The station operator should be familiar with typical diurnal (daily) concentration variations (e.g., the times daily maximum concentrations occur and the interrelationship of pollutants). For example: carbon monoxide (CO), nitric oxide (NO), and hydrocarbon (HC) concentrations usually increase and decrease together; NO and ozone (O_3) cannot coexist at high concentrations; nitrogen dioxide (NO_2) and NO concentrations should never be greater than oxides of nitrogen (NO_x); methane (CH_4) plus non-methane hydrocarbon concentration should never be greater than total hydrocarbons (THC).

2. The station operator should be familiar with the type of instrument malfunctions that cause characteristic trace irregularities.

3. Cyclical or repetitive variations (at the same time each day or at periodic intervals during the day) may be caused by excessive line voltage or

temperature variations. Nearby source activity can also cause erroneous or non-representative measurements.

4. Traces showing little or no activity often indicate a loss of sensitivity, flow problems, or sample line leaks.

5. Nightly precision and/or span checks provide a means of detecting shifts in instrument performance (see Appendices G.4 and J.4). If instrument response varies by more than 10% from the expected value, your supervisor is to be notified.

2.0.2.3a ENVIRONMENTAL MONITORING COMPANY (EMC) MODEL SM-2000 STATION MANAGER DATA LOGGER

The EMC Station Manager Model SM-2000 is a PC-based logger specifically developed to meet the needs of ambient air quality monitoring users. EMC Station Manager data loggers are used to collect, process, and report air quality data for the ARB's statewide air monitoring network. EMC data loggers located in air monitoring stations convert the analog output of various analyzers (ozone analyzers, carbon monoxide analyzers, etc.) into digital minute- and hour-averages. These averages are polled over telephone lines via an Air Quality Data Acquisition System version II (AQDAS-II) communication server and stored in a SQL database on an AQDAS-II file server.

ENVIRONMENTAL SYSTEMS CORPORATION (ESC) - 8800 DATA LOGGERS

ESC Data Loggers are microprocessor-based data acquisition systems designed specifically to acquire, process, store and telemeter environmental data. The standard unit consists of a microprocessor, analog to digital converter, random access memory, read-only memory, power supply, and battery backup for the clock and data storage. These data averages are polled over telephone lines using AQDAS-II polling software and stored in a SQL database on an AQDAS-II file server.

Air quality data in the SQL database are then made available through the Local Area Network (LAN) using EMC's System Manager. System Manager is the central data management software for AQDAS-II. It allows station technicians, second and third level reviewers to access and manipulate air quality data gathered by data loggers.

2.0.2.4 STRIP CHART RECORDERS

1. Identification – Each 24-hour segment of the strip chart should be identified with the station name, site number, date, and the pollutant(s) measured. The identifying information should be entered at the 100% of full-scale edge, near the 0100 hours time line.

2. Establish Scale Factor – Determine the correct scale factor. Analyzer scale factors are set during calibration by setting an electronic span control so that the analyzer response matches a uniform concentration scale on the strip chart recorder. Concentration is read by applying the appropriate scale factor to the reading.

3. Establish Zero Reference (Baseline) – A zero baseline is determined for each 24-hour period. Each night the analyzers are periodically purged with a zero gas, and the baseline should reach a constant value during the purge period. If the baseline value is not at the zero, a correction is used to determine the hourly average. Indicate on the chart the baseline value used for each day and clearly mark the point of any baseline shifts. If the zero reference drifts more than two percent of full scale per day, the cause should be found and eliminated, and the data should not be reported unless an appropriate baseline can be determined.

4. Determine Hourly Average Concentration – Determine the average pollutant concentration by visually averaging the trace for each hour. When the concentration is quite variable, the average value can be determined by drawing a line, which divides the trace into two or more equal sections of time. Then determine the average for each interval and combine to yield the hourly average. Record the hourly average on the strip chart next to the hour. Use colored pens or pencils matching the recorder trace (see Section 2.0.1.1, 1).

   NOTE: This is only done when the Data Logger is inoperable.

5. Notes on Charts – Enter meaningful notes on charts. The more information that can be provided, the more valuable the strip charts will be. Draw an arrow from each note to the area of the chart discussed. For example, notes should include:

   a. The cause of, or comment on, irregularities in the trace, e.g., changes in zero from day to day, sudden changes in the trace, flow errors, or corrective actions.

b. Checks and/or adjustments to the analyzer(s) (e.g., zero and span checks).

2.0.2.5 DATA TRANSMISSION TO HEADQUARTERS

Air quality data is transmitted to headquarters via AQDAS-II. Data averages are polled over telephone lines using an AQDAS-II communication server and stored in a SQL database on a file server located at headquarters. Regional workstations using EMC System Manager software can connect to the SQL database to access and edit air quality data gathered by data loggers.

2.0.2.6 REVIEW AND CORRECTION OF DATA ACQUISITION SYSTEM STATION TECHNICIAN - FIRST LEVEL REVIEWER AND SECTION SPECIALIST - SECOND LEVEL REVIEWER

Data editing, editor notes, calibration editor, calibration control charts, and monthly data matrix reports are done electronically on the EMC System Manager. Detailed instructions for operating the EMC System Manager are outlined in the attached "EMC System Manager Operating Guidebook."

Quality Control (QC) checks identify the operational condition of the monitor and assure quality data. A QC check is performed by introducing a standard gas of known concentration (the "expected value") into the sample stream of an air quality monitoring instrument (monitor) and recording the monitor's response. By comparing the monitor's response to the expected value, the degree of accuracy (expressed as % difference) of the monitor is determined. QC checks are automatically run between 0400-0500 hours daily at air monitoring stations. (Statistical evaluation of QC check responses to an identical standard gas provides a measure of the monitor's precision.) Like air monitoring instruments, QC systems may fail, yielding invalid QC data.

The following applies only to valid QC data:

1. The percent difference is calculated between the monitor's response value and the expected source value. When the percent difference is less than +/-10%, we can assume that the monitor is operating properly and the ambient data bracketed by acceptable QC checks are valid. If the percent difference exceeds the control limit of +/-15%, ambient data collected before and after that QC checks are not valid.

2. View "Calibration Control Charts" using the System Manager. (For detailed instructions about "Calibration Control Charts", see page 16 of the Guidebook.) Review Calibration Control Charts to see if the data values are within the upper and lower control limits (+/-15%).

3. View QC data using the System Manager's "Calibration Editor." Review the Source column, Response column and Difference column for outliers, and for incorrect expected source values or percent difference values that are greater than +/-10%. (For detailed instructions about using the Calibration Editor, see page 10 of the Guidebook.)

4. Establish QC data validity by referring to strip charts, analyzer maintenance sheets, and by checking for correct source values.

5. When the +/-10% limit is reached, corrective action is taken to bring the variation to less than +/-10%. Investigate the reason why the QC data are out of control limit by:

   FIRST LEVEL REVIEWER: Determine whether an instrument malfunctioned, calibrator malfunctioned, or leaks exist between the analyzer and the calibrator. Troubleshoot and repair the problem in a timely manner.

   SECOND LEVEL REVIEWER: Contact the station technician and notify him/her that the QC data indicates a problem exists. Inquire whether the problem was identified and repaired. Determine validity of reading by confirming the expected source gas values, interpolation of strip charts for correct response values, or flagging the data invalid. Edit data as required, using the "Calibration Editor." (For detailed instructions about Calibration Editor, see page 10 of the Guidebook.) In addition, corrective action taken **must** be documented in the System Manager's "Editor Notes".

   Re-review the Calibration Control Chart on the EMC System Manager to confirm that the edits were made.

REVEIW AND CORRECTION OF DATA FROM DATA ACQUISITION SYSTEM - STATION TECHNICIAN

1. Review data logger hourly values and strip charts on a frequent basis (daily if possible) to confirm normal operation of monitors, and take corrective action in a timely manner, if required.

2. Review daily zero/precision/span data recorded by the AQDAS-II. When span/precision data are outside the +/-10% advisory warning limit, troubleshoot the problem and take corrective action. If the zero drift is greater than +/-½ of reported unit, make a zero correction to the ambient data by adding the absolute value of the zero, if negative, or subtracting the absolute value, if positive. Do this for all data collected 12 hours prior to the zero check and 12 hours after the zero check. Document the corrective action in the station log book, analyzer monthly maintenance check sheet, and on the appropriate recorder strip charts.

3. Review data for outliers, maximum, minimum, consistently recurring data values, and automatically flagged values.

4. Establish data validity by referring to strip charts and analyzer maintenance sheets.

5. Edit data as required by either flagging the value as valid, invalid, or by changing the value by interpolation of the strip chart. To edit a value, use the EMC System Manager's "Hourly Data Editor". (For editing instructions, refer to the EMC System Manager Operating Guidebook, page 4). In addition, corrective action taken **must** be clearly documented in the System Manager's "Editor Notes". (For detailed instructions about the "Hourly Data Editor" refer to page 4 of the Guidebook.). Annotate a note for all data changes and the reason for changes using the System Manager's "Editor Notes". Submitting complete and accurate electronic notes are important. It allows the first level reviewer to document analyzer performance, malfunctioning instruments, or indicate interference. At the end of the month, the station technician can refer to electronic notes for data validation. These notes are needed during the second level review.

6. Save Edits-Be sure to save edits in the "Hourly Data Editor". Saving the changes updates the SQL database. System Manager automatically creates an "Edit Trail" that records the edit session, date, editor's name and other

activities. (For detailed instructions on the Edit Trail, refer to page 8 of the Guidebook).

FIRST LEVEL REVIEW COMPLETED: The station technician **must** enter a note in the "Editor Notes" for each parameter edited, stating that editing was completed for a given month. The technician then forwards the strip charts (with corrections annotated) and analyzer maintenance sheets to the second level reviewer for further validation.

SECOND LEVEL REVIEW COMPLETED: The section specialist **must** enter a note for each parameter reviewed and/or edited in the "Editor Notes" stating that second level review was completed for a given month. The section specialist then forwards the strip charts (with corrections annotated) to the Special Purpose Monitoring and Data Support Section. This step notifies AQDAS-II System Administrators that data are complete and ready for submittal to the U.S. EPA's Aerometric Information Retrieval System.

2.0.2.7 SPECIFIC CRITERIA FOR DATA VALIDITY

1. Hourly average:

   a. At least 30 continuous minutes of valid data are required to determine an hourly average.

   b. If the pollutant concentration exceeds 25% of full scale and varies substantially (maximum value: minimum value is greater than 2), 45 minutes of data are required for a valid hourly average.

   c. In determining the hourly average concentrations by either a or b above, disregard both recorded excursions lasting less than ten minutes and excursions that indicate obvious deviations from actual conditions in the surrounding area.

2. Valid day – Data recorded for a 24-hour period is defined as valid (and the maximum hourly average concentration valid) if the following criteria are met:

   a. In each of the three 8-hour segments of a 24-hour day (0000-0759; 0800-1559; 1600-2359), at least 6 hours of valid hourly average concentrations have to be recorded.

   b. Three consecutive unrecorded hourly averages will result in an invalid day of data